



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/608,347	06/27/2003	Chin-Tien Yang	TSM02-1234	8752
43859	7590	11/26/2004	EXAMINER	
SLATER & MATSIL, L.L.P. 17950 PRESTON ROAD, SUITE 1000 DALLAS, TX 75252			PERKINS, PAMELA E	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 11/26/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/608,347

Applicant(s)

YANG ET AL.

Examiner

Pamela E Perkins

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 September 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 and 21-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 21-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This office action is in response to the filing of the request for reconsideration on 7 September 2004. Claims 1-10 and 21-23 are pending; claims 11-20 have been cancelled.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 5, 6, 21, 22, 25-28, 31 and 32 are rejected under 35 U.S.C. 102(b) as being anticipated by Park (5,930,670).

Park discloses a method of fabricating a tungsten plug where a substrate (21) has a lower portion and a layer of selected material (24) over the lower portion, the selected material (24) having a top surface; defining a trench (20) in the selected material (24) extending from the top surface toward the lower portion; depositing a layer of tungsten (26) over the top surface of the layer of selected material (24), the tungsten (26) also filling the trench (20); polishing the tungsten layer (26) to remove a top portion of the tungsten layer (26); stopping the polishing so as to leave a reduced thickness of the tungsten layer (26) (Fig. 3B); and providing a contact area (27) over at least a portion of the tungsten (26) filled trench (20), wherein the contact area (27) in electrical contact with the tungsten (26) filling the trench (20). Park further discloses the substrate

Art Unit: 2822

including a conductive area (23) covered by the layer of selected material (24) and wherein the trench (20) is a via extending through the layer of selected material (24) and the tungsten (26) in the via is in electrical contact with the conductive area (23) (col. 4, lines 22-60). Park also discloses the layer of selected material (24) is one of a layer of a dielectric material and a layer of insulating material (col. 4, lines 22-39). Park discloses depositing a liner material (16) in the trench (15) and over the top surface of the selected material (14) before depositing the layer of tungsten (18) (col. 3, lines 22-62).

Referring to claims 21 and 27, Park discloses removing at least part of the reduced thickness portion of the metal/tungsten layer (26) during the forming of the contact pad (27) (Fig. 3C; col. 4, lines 51-60).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4, 7-9, 23 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Kobayashi (6,610,597).

Park discloses the subject matter claimed above except the contact area and the conductive are made of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum.

Kobayashi discloses a method of fabricating a tungsten plug where a substrate (007) has a lower portion and a layer of selected material (008) over the lower portion, the selected material (008) having a top surface; defining a trench (021) in the selected material (008) extending from the top surface toward the lower portion; depositing a liner material (003) in the trench and over the top surface of the selected material (008); depositing a layer of tungsten (005) over the top surface of the layer of selected material (008), the tungsten also filling the trench (021); polishing the tungsten layer (005) to remove a top portion of the tungsten layer (005); and providing a contact area (010) over at least a portion of the tungsten (005) filled trench (021), wherein the contact area (010) is in electrical contact with the tungsten (005) filling trench (021). Kobayashi further discloses the substrate (007) including a conductive area (009) covered by the layer of selected material (008) and wherein the trench (021) is a via extending through the layer of selected material (008) and the tungsten (005) in the via is in electrical contact with the conductive area (009) (col. 10, line 19 thru col. 11, line 67). Kobayashi also discloses the layer of selected material (008) is one of a layer of a dielectric material and a layer of insulating material (col. 10, lines 19-34). Kobayashi discloses making the contact area (010) and the conductive area (009) of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum (col. 1, lines 29-41; col. 10, lines 19-26).

Since Park and Kobayashi are both from the same field of endeavor, a method of fabricating a tungsten plug, the purpose disclosed by Kobayashi would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one

ordinary skill in the art at the time the invention was made to modify Park by the contact area and the conductive are made of a conductive material selected from the group consisting of copper, aluminum and an alloy of copper and aluminum as taught by Kobayashi to prevent plug loss (col. 12, lines 1-7).

Referring to claims 4, 23 and 29, Park discloses reduced layer of tungsten remaining after polishing is between 500 and 1000 Å (col. 4, lines 40-50). It is noted that the specification contains no disclosure of either the critical nature of the claimed concentrations or any unexpected results arising there from. It would have been obvious to one of ordinary skill in the art to form reduced layer of tungsten remaining after polishing is between 0.3 µm and 0.01 µm since it has been held that "In such an situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range." *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990) See MPEP § 2144.05.

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park in view of Bhowmik et al. (2003/0091870).

Park discloses the subject matter claimed above except the liner material is selected from the group consisting of tantalum, tantalum nitride, titanium, and titanium nitride.

Bhowmik et al. disclose a method of fabricating a tungsten plug where a substrate has a lower portion and a layer of selected material (20) over the lower portion, the selected material (20) having a top surface; defining a trench (25) in the

selected material (20) extending from the top surface toward the lower portion;
depositing a liner material (30) in the trench (25) and over the top surface of the
selected material (20); depositing a layer of tungsten (60) over the top surface of the
layer of selected material (20), the tungsten (60) filling the trench (25); and polishing the
tungsten layer to remove a top portion of the tungsten layer (60) (para. 12-14).

Bhowmik et al. further disclose the liner material (30) is selected from the group
consisting of tantalum, tantalum nitride, titanium, and titanium nitride (para. 4).

Since Park and Bhowmik et al. are both from the same field of endeavor, a
method of fabricating a tungsten plug, the purpose disclosed by Bhowmik et al. would
have been recognized in the pertinent art of Park. Therefore, it would have been
obvious to one ordinary skill in the art at the time the invention was made to modify Park
by the liner material is selected from the group consisting of tantalum, tantalum nitride,
titanium, and titanium nitride as taught by Bhowmik et al. to improve reliability of the
tungsten plug (para. 4).

Claims 24 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable
over Park in view of Matsubara et al. (6,268,090).

Park discloses the subject matter claimed above except a wafer having a
diameter of more than 200 mm.

Matsubara et al. disclose a method of fabricating a contact plug where a
substrate (101) has a lower portion and a layer of selected material (104) over the lower
portion, the selected material (104) having a top surface; defining a trench in the
selected material (104) extending from the top surface toward the lower portion (Fig. 2B;

col. 3, lines 50-62); depositing a liner material (105) in the trench and over the top surface of the selected material (104) (Fig. 2C; col. 3, lines 5-12); depositing a layer of metal (109) over the top surface of the layer of selected material (104), the metal also filling the trench (Fig. 3A); and polishing the metal layer (109) to remove a top portion of the metal layer (109) (Fig. 3B; col. 4, lines 13-21).

Referring to claims 24 and 30, Matsubara et al. disclose a wafer (1) having a diameter greater than 200 mm (col. 1, lines 26-34).

Since Park and Matsubara et al. are both from the same field of endeavor, a method of fabricating a contact plug, the purpose disclosed by Matsubara et al. would have been recognized in the pertinent art of Park. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Park by the wafer having a diameter of more than 200 mm as taught by Matsubara et al. to prevent peeling (col. 47-56).

Response to Arguments

Applicant's arguments filed 7 September 2004 have been fully considered but they are not persuasive. As stated above, Park discloses the method of reducing the circuit failure caused by tungsten plug pulling out of an apparatus as described in claims 1, 21 and 27.

In response to the applicant's arguments, the applicant argues the cited references do not disclose, teach, suggest, or motivate a method of reducing integrated circuit failures in an integrated circuit chip caused by metal plug pull-ups and pull-outs

while making the chip, where the method includes polishing the metal layer to remove a top portion of the metal layer, and stopping the polishing to leave a reduced thickness portion of the metal layer adjacent to the aperture chip, forming a contact pad at least partially over the metal filled aperture, and removing at least part of the reduced thickness portion of the metal layer during the forming of the contact pad.

However, Park does disclose a method of reducing integrated circuit failures in an integrated circuit chip caused by metal plug pull-ups and pull-outs while making the chip, where the method includes polishing the metal layer (26) to remove a top portion of the metal layer (26), and stopping the polishing to leave a reduced thickness portion of the metal layer (26) adjacent to the aperture (20), forming a contact pad (27) at least partially over the metal-filled aperture (20), and removing at least part of the reduced thickness portion of the metal layer (26) during the forming of the contact pad (26) (Fig. 3A-3C; col. 4, lines 22-60).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not

mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


AMIR ZARABIAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

PEP